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FURTHER INVESTIGATION OF THE PUPILLARY NEAR REFLEX*

THE EFFECT OF ACCOMMODATION, FUSIONAL CONVERGENCE AND THE PROXIMITY FACTOR ON PUPILLARY DIAMETER

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In a previous paper,[1] the factors which combine to make up the pupillary near reflex were discussed. Experimentally it was found in the subjects studied that accommodation always elicits a pupillary constriction and that fusional convergence does also in about half the individuals but to a lesser degree than accommodation. A proximal factor was indicated which, if present, is insignificant in magnitude relative to the other two factors.

This paper is devoted to two things: first, to the application of a procedure with which the proximal factor in the pupillary near reflex may be more carefully examined and second, to the addition of more data concerning the role of accommodation and fusional convergence in the near reflex.

HISTORY

Investigation of the function of accommodation and convergence in the elicitation of the pupillary near reflex has a history as long as that of the subject of physiological optics itself. But the proximal factor, the psychic appreciation or awareness of the nearness of the object of attention, divorced from all other factors, has been comparatively neglected. It has been disregarded partly because the early workers in the field did not consider it and partly because of the great difficulty of isolating it owing to its subtle psychological nature.

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An attempt to separate the proximity factor from accommodation and convergence was made by Kestenbaum and Eidelberg[2] in an extensive investigation of the near reflex. They performed three experiments.

First a subject fixated Jäger letters at 15 cm. while looking through lenses and prisms to prevent accommodation and convergence. Then without these optical aids he looked off at 6 meters distance. By alternating between these two fixations, no "noteworthy" or "essential" change of pupillary size could be detected although the only change in the stimulus was proximity. Unfortunately, the authors used only one subject, assumed that the optical stimulus to accommodation was equivalent to the accommodative response and determined pupillary diameters almost qualitatively.

Their second experiment consisted of a modified stereoscope used in the following way. The subject fixated a target at 6 meters distance with one eye through an empty lens cell while the other eye with a +10 D. lens centered before it, fixated on a small target at 10 cm. The near target was adjusted laterally so that the image for the left eye at 10 cm. was superimposed upon an identical letter in the 6 M. visual chart visible to the right eye. The subject is said to have given his attention to one target, suppressing the other. In so alternating his attention, no change in pupillary size was observed.

In order to overcome any objection which may be introduced by a stereoscopic effect, Kestenbaum and Eidelberg repeated this experiment with dissimilar targets for the two eyes and obtained the same results.

The objections to their first experiment also apply to their second. In addition, it would be difficult to demonstrate complete suppression for one eye and equally difficult to establish that suppression negates the proximity cues received by that eye.

For their third experiment a myopic subject with one eye occluded, was required to change his fixation from the distance to a near point which was, however, beyond his far point. Despite a change of proximity there was no pupillary change. The objections here are obviously similar to those for the first experiment.

Since Kestenbaum and Eidelberg could find no response to proximity alone and found miosis with every instance of convergence as they interpreted it, they disagreed with Behr's term, "near reflex" *(Naheinstellungsreaktion)*, and called this phenomenon, as it had been called in the past, the "convergence reflex of the pupil." *(Konvergenzreaktion der Pupille)*.

APPARATUS AND PROCEDURE

The reader is referred to the original paper[1] for details of the

equipment and the basic procedure: a general review of it follows.

As before, pupillary diameters were recorded by infrared photographs of the left eye. A haploscope with a point-source optometer on the right arm was used with König bar targets for fixation and illuminance reset for each fixation distance by a flicker standard. Fixation distances used were 5,1,1/3 and 1/5 meters. To find the effect of accommodation and the proximal factor,* accommodation was varied by lenses in approximately 1 diopter steps before the right eye, the left being occluded. By this procedure the apparent pupillary diameter could be plotted against accommodative response measured at the eye for each fixation distance.

For the effect of fusional convergence, various prisms both base-in and base-out were used before the eyes with the target at 5 M. No allowance for the change in effectivity of the prisms caused by ametropic corrections was made because in the two subjects having sizeable corrections one (J. F.) showed no pupillary effect as a result of fusional convergence which makes the true value of the prism of little importance. The other (R. M.) had a small fusional reserve making the error insignificant since the prisms were small in value.

The order in which prisms or lenses were used was reversed in half the subjects. Also half had all four fixation distances taken in the same sitting whereas the other half had them taken in pairs, usually a day or two apart. This was an attempt to compromise between the possible effects of fatigue and changes in response from one day to another.

In this investigation no correction was made for the changes in retinal illuminance brought about by changes in pupillary size because the original work indicated that no appreciable error is introduced thereby.

Eight of the 10 subjects were seniors in the School of Optometry of the University of California. Six of these had previous experience of an elementary nature in the use of the haploscope.[3] Each subject had a trial run before each set of measurements was taken. Their knowledge of the purpose of the experiment at the time was rudimentary.

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*Little is known about the relationship of the type and strength of the various proximal cues to the motor responses they may engender. For example, in two investigations of proximal convergence[5, 6], strong and varied cues were available since the subject could see his target in relation to the whole room. The necessity for so many cues in this relationship has never been established. Because of the necessary control of illuminance in this experiment, the targets could be seen only through field stops which blocked off the rest of the room. The subject could see how near the target was before the taking of data began and he also had some space cues from minor blemishes on the target ground.

The other two subjects were graduate students with considerable haploscopic experience.

It is difficult to know how to choose subjects in an experiment of this nature where psychic proximity factors enter. It is usually desirable to have experienced observers, skilled in making judgments and settings: but on the other hand, an experienced observer in gaining his skill loses his naiveté. For example, the novice looking through a stereoscope with one eye occluded may accommodate in spite of the target being *optically* distant and see the target blurred apparently because of the *physical* proximity of it.* This observer would seem to be much more likely to exhibit a proximal pupillary effect than the experienced observer who has evidently learned to subordinate the psychic stimulus to the optical stimulus. From this point of view the inexperienced subject should best demonstrate the above mentioned reflex if one exists. However the novice will in general give more variable results. In Figure 1 may be seen an example of data impossible to use. Here the stimulus to accommodation was varied by lenses from 0 to 5 D. at each of the

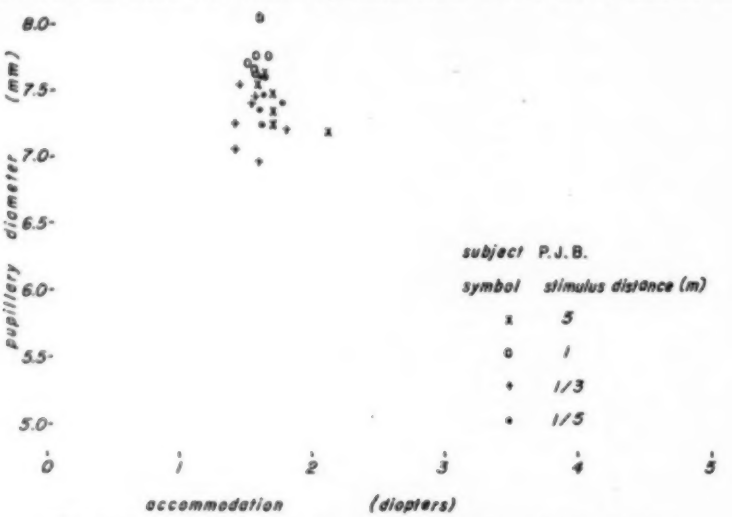

Fig. 1. Lack of response to change of optical accommodation stimulus.

*In the literature there are records of two attempts to measure proximal accommodation[5, 6] and both gave negative results. The frequency with which the optometrist sees what appears to be a special stimulus to accommodation (whether it is attributable to the proximity of the target or to the optical stimulation of close peripheral borders of the instrument aperture) raises the question of the character of the sampling and the training in these experiments.

four fixation distances while accommodation responded little if at all.

RESULTS

PD/C Values

If, as in the original paper, the subjects are divided into two groups, those with a definite PD/C (the ratio of pupillary diameter to fusional convergence) and those with one of zero (<0.01 mm./△), each group contains five subjects. This grouping is in excellent agreement with the original work where two subjects fell into the first classification and three into the second. Also this grouping is in good agreement with Knoll[4] who found that four of his 10 subjects had similar significant changes of the pupil with fusional convergence.

There is an exceptional agreement between the average definite PD/C value of the five subjects in this experiment (0.053 mm./△), and in the two in the original work (0.052 mm./△). It is felt, however, that such close agreement is more fortuitous than precise. Values for all subjects are given in Table I.

PD/A Values

As in the original work, the *PD/A* function (ratio of pupillary diameter to accommodation) is seen to be linear. In five subjects the *PD/A* values or slopes of the lines are fairly constant for the various

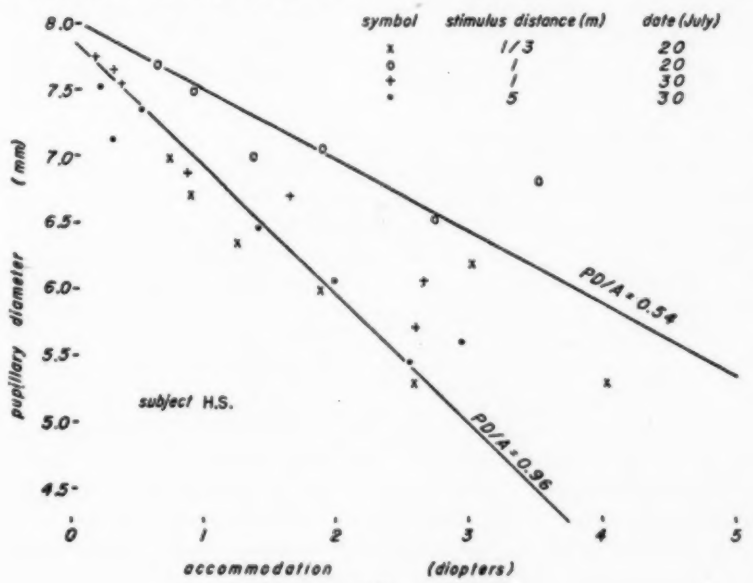

Fig. 2. Instability of PD/A.

TABLE 1.

Subject	P.F.B.	P.J.B.	J.F.	W.F.	B.G.	R.H.	F.J.	D.L.	R.M.	H.S.
PD/C	0.038	0.015	0.000	0.028	0.000	0.000	0.083	0.000	0.102	0.000
PD/A	‡	‡	0.46	0.55	0.77	0.35	0.22	0.31	*	0.75

Mean *PD/C* (of definite values) = 0.053 mm./Δ.
Mean *PD/A* = 0.48 mm./D.

* not linear.
‡ accommodation did not respond to change of accommodative stimulus.

fixation distances; in two others it varies widely in no apparent systematic way, even though the curves compared were taken at the same sitting.

The instability of one *PD/A* value may be seen in Figure 2, where on one day subject H. S. was taken first at 1/3 M. (he could not be measured at 1/5 M. because his accommodative convergence was too great for the haploscope) and then at 1 M. It is evident that the 1 M. run gives about half the *PD/A* value of the 1/3 M. trial. Ten days later runs were made at 1 and 5 M. This time the *PD/A* values agreed with the original one at 1/3 M. There is probably no simple answer to the sharp departure from a constant slope shown here except that this slope is not necessarily a fixed one.

The *PD/A* value for each subject is found by taking an average of his available individual slopes for each distance when differences occur and are recorded in Table I. It may be noted that the mean of all these values is 0.48 mm./D. which may be compared with 0.30 found in the original work.

The Proximal Factor in Pupillary Constriction

Of the seven subjects who had usable *PD/A* graphs, only one indicates a proximal factor in the pupillary near reflex. Inspection of Figure 3 shows that the pupil was definitely larger at greater fixation distances with no difference in accommodation. If there is a proximal factor here, it apparently breaks down at the nearest stimulus distance. The curves for 1/5 and 1/3 M. were taken on one day and for 1 and 5 M. in that order two days later. Any error due to the excitement of the test causing a dilation of the pupil would work against the possible proximal effect shown here since the nearest fixation distances in each setting were taken first. One must be cautious in the interpretation of this graph, however, because it is quite possible that apparent proximal effect is only a random change such as that graphed in Figure 2.

The indecisive result found in Figure 3 was a goad to retake this subject. This was done all in one morning five months later. From his functions in Figure 4 it is seen that there is possibly some proximal effect in this subject, of the order of three-quarters of a millimeter.

In the other graphs no proximal effect was evident as may be seen in a typical subject in Figure 5.

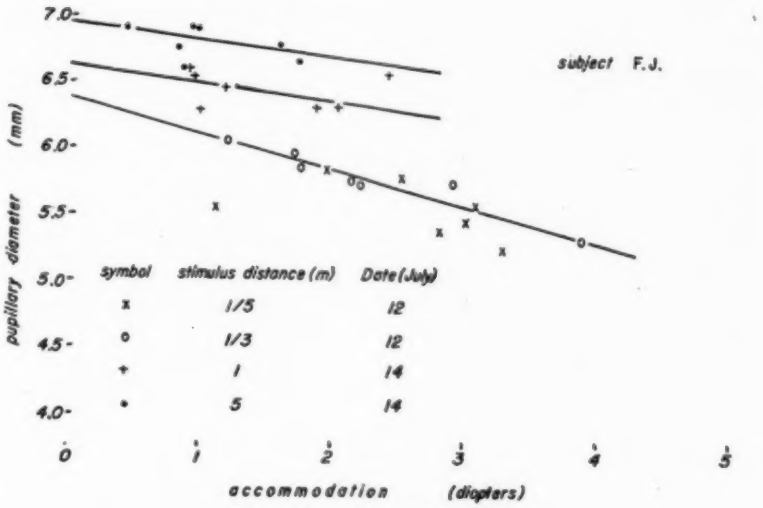

Fig. 3. A possible proximal effect.

DISCUSSION AND CONCLUSIONS

Knoll,[4] in a paper which was published when this investigation was in the data-taking stage, has found several things which appear at odds with the work of the writers.

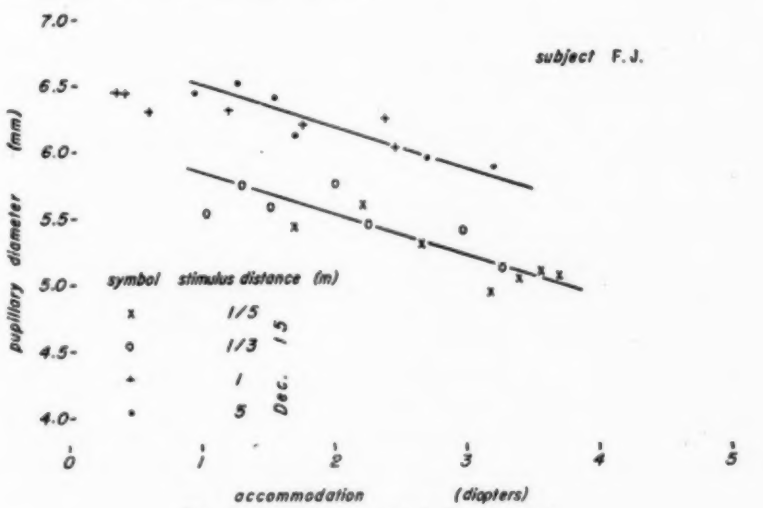

Fig. 4. A possible proximal effect (retake).

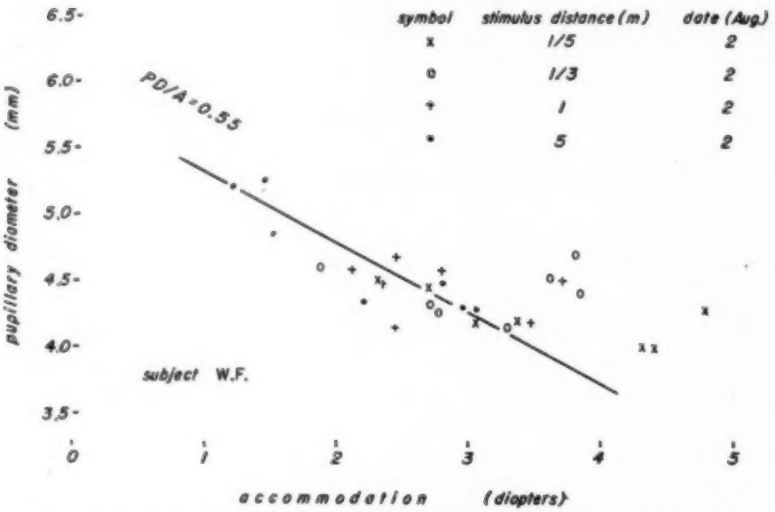

Fig. 5. Typical PD/A graph for the experiment showing the general lack of a proximal effect on the pupil.

First, Knoll found an interaction of accommodation with fusional convergence making the pupillary effect of fusional convergence depend on the accommodation in force. We find no such phenomenon.

Another difference — minor though it may be — is that Knoll showed that significant pupillary effects associated with fusional convergence are found in those subjects with large fusional reserves. We could find no such relationship between the *PD/C* and fusional amplitude.

Finally, Knoll's data suggest a possible correlation between *PD/A* and *AC/A* which, if true, is of neurological significance. However, in our investigations the *PD/A* values are not repeatable enough to attempt a like correlation. When as illustrated in Figure 2 the *PD/A* values can change by almost a factor of two, it would take an elaborate statistical study to see if any such relationship existed.

In general, however, the results of our investigations are in very good agreement with Knoll's findings.

The contention of Kestenbaum and Eidelberg[2] that the near reflex of the pupil should be called the convergence reflex of the pupil may now be examined more critically in the light of the data presented here. That fusional convergence helps to elicit the reflex is apparently true only half the time. Accommodative convergence is a function of accom-

modation and should in any one individual, it would seem, be considered with it. Nearness, in an isolated sense, does not commonly appear to result in pupillary constriction. Therefore, the term "accommodative reflex of the pupil" appears to be most descriptive of the physiological processes involved. But since: (1) fusional convergence does sometimes play a part, and, (2) under normal conditions the reflex is a response, albeit, indirect, to a near stimulus (psychological nearness alone need not be implied), and, (3) the term "near reflex of the pupil" has wide usage in the literature; it is reasonable to retain this term of Behr regardless of his original basis for it.

As to the proximal factor in the near reflex, it appears to be uncommon if, indeed, it does exist at all. Kestenbaum and Eidelberg were evidently correct about this point in spite of their crude methods and their elementary concept of convergence.

SUMMARY

In a further investigation of the pupillary near reflex and the psychic proximal factor, it is found for 10 subjects that:

1. There is excellent agreement with the original work where five subjects were used.
2. The proximal pupillary factor, i.e. a constriction of the pupil associated with an increase of psychic awareness of nearness of the target with accommodation unchanged, was investigated. For the subjects examined no such phenomenon was generally observed. In one subject, however, there was possibly such an effect.

It is concluded that Behr's term, "the near reflex of the pupil" *(Naheinstellungsreaktion der Pupille)* is consistent with the present experimental findings and should be retained in place of alternate terms such as "the convergence reflex" or "the accommodative reflex" of the pupil.

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‡THE VISUAL EXAMINATION OF THE PATIENT PAST FORTY*

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The actual visual tests performed on the patient past 40 are nearly the same as those of any other mature age group. Additional tests are required of patients in the presbyopic group but in addition to those attention is directed to certain points which should be emphasized because of the physical, mental and visual changes which have been listed in the preceding papers.‡

HISTORY

The value of a complete history increases with the age of the patient. Because of the years involved the chances are greatly increased for the accidents of living to take their toll from the patient. The importance of the general health to the entire visual mechanism cannot be overemphasized and it is obvious that more detailed questions must be asked in the older age group on this important matter.

It is not enough to know just a man's occupation when he is past 50. Details must be obtained as to the exact distances involved as well as the location of the work in regard to the level of the head. If there is any doubt expressed concerning these important points exact measurements should be taken. An optometrist should make a study of every type of occupation and its visual requirements. In many cases an actual visit to the man's work, if it is an unusual occupation, is advisable. Borish[17] emphasizes the importance of inquiring into the illumination and general conditions such as amount of fixed attention and tedium involved. This is especially important in the 40 to 65 age group.

Closer attention is also advocated to the patient's hobbies. Detailed questions should be asked concerning hobbies which are pursued extensively. To record "fishing" as a man's hobby is not sufficient. Fly fishing, for example, requires the use of eyes at frequent intervals at about 13 inches. A bifocal for this case, though, should also be set sev-

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†Optometrist, Fellow, American Academy of Optometry.

‡This is Part III of the paper, "Geriatrics and Optometry." Part I appeared in the March issue. Part II, "Visual Changes with Age," appeared in the April issue.

[17]Borish, Irvin M. Clinical Refraction. The Professional Press, Inc. Chicago, Ill. 1949. p. 93.

eral millimeters lower than the average because of the amount and kind of walking involved. All patients should be informed of the need for different types of lenses for various kinds of visual tasks so that they feel free to consult the optometrist as these problems arise.

EXTERNAL EXAMINATION

Irritation is noticed frequently on the conjunctiva both from mechanical causes and from mild conjunctivitis. A careful, detailed examination should be made of the cilia and conjunctiva. There are several aids available to the examiner which may be used. The small polarized operating lamp, illuminated magnifying lenses, or binocular loupes are among the examples.

TRANSILLUMINATION

This technique is indicated frequently in the period of later maturity because of the seriousness of focal infections in this age group.

OPHTHALMOSCOPY

The ophthalmoscopic examination is extremely important due to the greater frequency with which eye diseases occur in the later years. A more detailed inspection should always be made of the lens, of the nerve head, of the macular area and of the vessels in the patient past 40. Perhaps the safest method is to actually suspect cataracts, glaucoma, or retinal degeneration in every patient examined.

RETINOSCOPY AND SUBJECTIVE

No special emphasis is necessary in these tests for either the senescent or senile group except to remember that excessively long tests tire the older patient and many times defeat their purpose. It is often best to make a subsequent examination if the original one tends to become too lengthy. Morning examinations are recommended if the patient is known to be in the senile group.

PHORIAS AND DUCTIONS

These measurements are performed the same at any age and should not be slighted. It is important that the patient in the senile group understands the instructions in these tests, as they are many times confusing to older people. As these tests are entirely subjective it is advisable to repeat any suspicious findings to make sure of their validity in the older age group. Prism corrections, for example, should be confirmed by at least three different methods and should agree quite closely.

NEAR POINT TESTS

These tests assume additional importance for the patient past 40. There is such a variety of them, though, with each practitioner having

his favorite methods, that it is not necessary to list them. The effect of proper illumination should be considered in these tests as a result of the investigations reported earlier in this paper. A lamp approximating that which should be used in the average home or office is recommended. An excessively bright light or ceiling illumination only will tend to give an entirely different picture of the accommodative function.

SPECIAL TESTS

Many practitioners like to set up the final lens correction in a trial frame for the patient. This reveals many traits peculiar to the individual in his reading habits, etc. It also helps to explain the peculiarities of certain types of lens corrections to the older patient.

Visual fields are indicated more often in the period of later maturity. Careful instructions are important in these measurements. It is also well to remember that the patient past 60 usually does not hear as well. Some contraction of the fields with age is normal as mentioned previously.

The practical application of the visual skills measurements has less significance for patients in these later age groups.

The scleral tonometer should be a part of every optometrist's equipment. Due to the seriousness of glaucoma every method possible should be used to detect it at its earliest inception. While the scleral tonometer should not be regarded as an infallible method of detecting glaucoma it is an aid in making the final diagnosis and in following the success of any course of treatment.

THE FINAL CORRECTION AND ADVICE TO THE PATIENT PAST FORTY

Optometry's forte for the older age group lies in helping to make this period of life more worth living. With the reduction of physical stamina so common to this period increased use of the eyes is the general rule. Much careless advice has been given to patients in regard to "saving their eyesight." There are no statistical data to substantiate the theory that use of the eyes wears them out. This advice only serves to make visual hypochondriacs out of otherwise normal patients.

Proper visual habits are essential to bring about the best possible visual efficiency at any age. Instructions regarding use of lights, length of reading periods, and proper posture should not be merely discussed with older patients but should be written out for them. The physician making a diet list for the patient does not rely on the patient's memory. If it is important that the patient use his eyes under the proper conditions then we should do everything possible to see that he follows through on this important phase of our work. It is necessary in this

regard that we stress the importance of proper illumination. This is true because of the various changes in the eye, especially the reduced pupil size, which are normal with aging.

The saying, "forewarned is forearmed," has a place in patient instruction. The elderly patient especially doesn't like to be unpleasantly surprised. It is only prudent to warn the patient of difficulties to be encountered in bifocal changes, cylinder modifications, and any general lens change. Usually if we explain fully the trouble likely to be encountered so that the patient is expecting the worst he will be better prepared mentally for it. Most patients appreciate the assurance that comes from knowing that their problem is a normal one which is to be expected.

Due to the trend away from emphasis on ophthalmic materials there has been a tendency to belittle the value of the proper care of glasses when prescribed. For the bifocal patient periodic adjustments are more essential than for those wearing single vision corrections. The necessity of these adjustments should be carefully explained to each patient.

The patient should be warned about the reduction in some of the abilities required for modern driving. A reduced speed would be advisable for patients in the later maturity group or beyond. Night driving for any patient past 60 is dangerous because of reduced glare resistance.

The frequency with which subnormal vision is found in the senile group makes it necessary for each optometrist to develop the proper philosophy in treating these patients. Vics,[18] in discussing the importance of intelligent handling of these cases, emphasizes the somatic dysfunctions such as hypertension, defects in speech, gastro-intestinal upsets, as well as many others which have been associated with these people who live under the constant tension of trying to see. Vics further emphasized in presenting this paper before the American Academy of Optometry, that the term "there is nothing more can be done for you," should never be used. The psychological "shock" of such a statement on many elderly people is extreme. A way out or some hope should always be emphasized when treating patients in the older age group.

Every optometrist has his own method of handling cataract cases, usually based on the operative techniques employed by the surgeon to whom he refers his cases. Cataracts can now be removed at the stage

[18]Vics, I. Irving. Comments on Psychosomatic Optometry with Reports of Subnormal Vision Cases. Am. J. Optom. and Arch. Am. Acad. Optom. Vol. 26. Feb. 1949. pp. 57 to 68.

at which they interfere with vision. This is a big help psychologically to the patient. The matter of informing the patient of his cataract has been so amply covered in the modern optometric curriculum that nothing more need be said here except to emphasize the fear that many older people have of this disease. As optometrists we see this problem so often it becomes difficult to remember that this is many times something new and frightening to a patient. The care and understanding used by us in our explanation can influence the patient's peace of mind for many years to come.

The optometrist should always discuss each referral with the physician concerned. For patients approaching the senile group it is best to make the appointment immediately. Patients at this age are prone to forget instructions and to minimize the necessity for further tests if time is allowed to elapse.

SOME GENERAL HEALTH RULES

Optometry is primarily concerned with adding "life to years" and we can actually do little directly as a profession in adding "years to lives." There are, of course, frequent exceptions which occur when an eye examination results in a reference to a physician and some serious illness is discovered as a result. The fact that as a profession we are able to improve distance vision, as well as provide efficient seeing for driving and industrial work, helps in preventing many accidents.

Most optometrists in taking histories are surprised to learn that many patients have never had a physical examination, or at least they have not had one in several years. Patients reaching 50 should realize that they are at a turning point physically. Diseases of the heart and arteries, cancer, nephritis and diabetes are best controlled if discovered early. An optometrist should have among his professional colleagues a physician interested in geriatrics for referral of cases for routine physical examinations. Optometrists, because they are so often consulted professionally before the patient experiences other symptoms of aging, have an excellent opportunity to assist in preventive medicine in this manner.

The Metropolitan Life Insurance Company has, for a number of years, pursued an outstanding program of public education which stresses the importance of good health habits if one is to enjoy the later years of life. Some of the points they have emphasized in pamphlets are as follows:

1. Eat well balanced meals including vegetables, eggs, fruit, milk, meat or fish, and cereal products. Remember that the food in-

take must be less past 35 because of the general slowing down of the bodily functions.

2. Get enough sleep to feel rested and alert in the morning. Many busy people find a daily half-hour rest at noon an invaluable aid.
3. Remember that "moderation is truly the basis of all right living," and live by it.
4. Follow hygienic measures by treating scratches and cuts promptly, washing hands before meals, using only clean eating and drinking utensils.
5. Realize that there are certain things which cannot be changed—growing old being one of them—and accept these things cheerfully for what advantages they bring.

Sir William Osler several years ago wrote a little classic entitled, "A Way of Life." To quote him, "The practice of living for the day only, and for the day's work, life in day-tight compartments . . . The load of tomorrow added to that of yesterday, carried today, makes the strongest falter." This philosophy is not intended to mean that one should not plan for the tomorrow, but once those plans or precautions are taken then live each day for itself. The actual living of this "way of life" has brought an inner peace to more than one harassed patient.

THE FINAL PRESCRIPTION

It was mentioned previously that there were several reasons for aversions to change among the aged. That such an aversion does exist has been forcibly brought home to more than one optometrist trying to make even a half diopter change in a cylinder. Even though all our tests point toward a certain lens correction, if it is a radical departure from the patient's way of seeing make it cautiously. In the period of later maturity (ages 40 to 60) more latitude can be allowed but even in that group the patient should be told of his chances of failure and let him make the choice. Beyond 60 there is considerable doubt if any radical changes should be made if the error is of long standing. There are a few obvious exceptions to this which can be selected usually by their younger mental attitude and willingness to take a chance.

Few optometrists try visual training in the older age groups. If correction is necessary prisms are usually preferable during the period of later maturity. Past 60, even prisms, if they have never been worn previously, cause considerable trouble during the adjustment period.

There is clinical evidence to support this aversion to changing some of the customary visual patterns of seeing in older people. Bannon and

Textor[19] in analyzing a hundred cases of failure and a hundred successful cases of correction by aniseikonic lenses have this to say in relation to age: "Twice as many young people were found in the successful group as in the failure group, while 70 per cent more of older people were in the failure group. In the middle group, 30 to 50, the number in both groups were about the same." In compensation lenses prescribed for vertical imbalances there is some evidence that the maximum age is even younger. Ellerbrock[20] reports that in 47 cases he investigated, patients under 25 were aided more by prismatic compensation that those over 25.

Changing the spherical element does not cause much difficulty for the patient in making adjustments except in large amounts. Cylinders, though, if never worn previously, are sometimes completely unsatisfactory if prescribed for the patient beyond 60. Even changing the base curve of a lens can cause trouble among senescents, and is worth investigating on problem cases if little other change is being made. The promiscuous changing of bifocals from a type previously worn satisfactorily for a number of years is also questionable.

SUMMARY AND CONCLUSION

The revived interest in geriatrics is a natural outcome of the lengthening life span. The necessity for studying people by age groups is based on the fact that old age is a physiologic entity like youth. For convenience, age groups were divided into the period of later maturity (40 to 60), the period of senescence (60 to 75) and the period of senility (75 on). Heredity, environment, infection, diet and drugs are factors which influence longevity. It is recognized that it is difficult to determine which changes are normal with aging and which are due to other factors. Progressive age changes taking place mainly in the cells and tissue, not due to diseases, were outlined. The effect of these changes on the digestive system, cardiovascular system and kidneys were studied. Mental changes such as irritability, loss of memory, loss of self-confidence, despondency and dislike of change are found commonly in old age.

A brief outline was presented of the visual changes taking place in the lids, cornea, iris, and sclera. The presence of small lenticular

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[20]Ellerbrock, V. J. A Clinical Evaluation of Compensation for Vertical Prismatic Imbalances. Am. J. Optom. and Arch. Am. Acad. Optom. Vol. 25, 1948, p. 324.

opacities in over 90 per cent of the people was noted. Bernstein's studies, which show that persons with early progressing presbyopia tend to die young and persons with late progressing presbyopia tend to die late, were discussed. Senile macular degeneration, so often seen in older people, must be differentiated from the similar degeneration due to other causes. Based on a study of 100 cases it was questioned if there is much loss of visual acuity for most patients past 60 if no pathology is present. The loss of ability to resist glare, which takes place in nine out of 10 patients past 60, constitutes a serious problem for drivers in this age group.

On the basis of the general physical, mental and visual changes which accompany aging certain points in the eye examination were stressed. A more complete history of the physical condition, occupation, and recreation should be taken on all patients past 50. Additional care should be taken in the external eye examination and during the ophthalmoscopic check. Illumination similar to that employed in the average home should be used for the near point tests. The use of the trial frame to demonstrate certain corrections was recommended. Scleral tonometry was mentioned as a possible aid in detecting glaucoma. There is a normal constriction of the visual fields due to the decreased circulation at the periphery of the retina in old age.

It is necessary to instruct the average patient both verbally and in writing on important points of eye care such as illumination, length of reading time, proper posture, lens adaptation, and care of ophthalmic materials. Some general health rules were outlined and special mention was made of the opportunity that optometrists have for referral of patients for physical examinations. Radical lens changes should be made cautiously, if at all, in the patient past 65.

As optometrists we recognize that eye changes are manifestations of general bodily conditions, but we must also remember that each organ has its own time curve of aging. We can best discharge our obligation to our older patients by basing our treatments and advice on geriatric principles directly applied to the visual problem.

WOOLWORTH BUILDING,
RAPID CITY, SOUTH DAKOTA

EYE PROTECTION FROM A MANUFACTURING AND DISTRIBUTING VIEWPOINT*

Samuel Gass†
Southbridge, Massachusetts

The American Optical Company's contribution to eye protection dates from 1909. In that year, Walter G. King became alarmed at the number of glass eyes being supplied industrial workers and made up our first form of eye protection known as the sani-goggle. This goggle was made of a metal frame and heavy unhardened glass. The sani-glass goggle was introduced to industry through the American Steel Foundries in their Chicago plant, which resulted in an immediate order for 72 pairs. A great demand for industrial safety goggles was soon realized.

About 1925 we began using the oil immersion process of lens hardening to provide greater resistance to impact. In later years this was changed to the present day method of toughened safety lens. This method consists of heating the lens to a predetermined temperature for a period of time determined by the size, thickness, and chemical composition of the glass and then the immediate cooling of the lens by compressed air.

Through our research and development department the American Optical Company has been a contributor to improvements in eye protection. We are constantly endeavoring to improve the present safety equipment.

Eye protective devices are primarily guards designed to meet very definite specifications in materials and protective efficiency against recognized industrial hazards. In order to assure the user of devices that will afford him maximum protection on the basis of their application to these industrial eye injury hazards, the American Optical Company cooperates with engineering technical groups responsible for the development of standards for protective equipment. These groups include the American Standards Association; insurance engineering groups that make up the material and specify the requirements for personal protective equipment affecting the hazards of the insurance companies' risks;

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the Federal Specification Board composed of technical governmental representatives charged with the development of specifications covering the design and use of eye protective equipment as it applies to federal agencies, and in many instances, the general manufacturer throughout the country.

From the experience of the technical personnel of these various groups, plus safety engineers recognized as specialists in specific industrial hazards, the basic principles of material and design as they affect personal protective equipment are developed, and then applied generally to the country's program as a whole.

As early as World War I, we fully appreciated the advantages in visual efficiency and protection offered by combining both correction and protection in one pair of goggles. We had the assurance of the research and development department that it was possible to put a prescription in a safety lens. We then learned, through research, that the minimum thickness of a hardened lens should be at least 3 mm. (This is now a national standard for safety lenses.) Calobar lenses, which most people think of in terms of sun glasses, were first developed as a safety lens for protection against dangerous rays outside the visible portion of the spectrum. The original type spectacle safety goggles had round lenses and a very limited range in eye and bridge sizes. The round lens was usually 50 mm. in diameter and did not fit well on the nasal side. The bridge was of the cylinder type. Again we were able to benefit by borrowing designs from the ophthalmic division. The parametric lens gave more protection to the nasal side of the eye and decreased the weight. The Sampson bridge and nose pads made possible fitting safety goggles to give comfort and satisfaction never before experienced. New plastic materials are constantly being developed for safety and ophthalmic use. However, we in the safety division are restricted in our choice of plastics, as in our choice of lenses and frames generally, by the factor of safety. We dare not use zylonite in safety frames because of its flammability.

As the distribution of safety goggles grew with the demand, they were always considered a commodity such as sun glasses. When we produced the first safety prescription goggles for direct distribution to industry, we became aware of our dual responsibility to the professions and industry. However, the procedures in acquiring materials long had been established by industry; as an example, non-focus goggles were purchased by industrial purchasing departments the same as lumber, steel or wire. The natural inclination was for laymen in industry to follow the same procedure in purchasing prescription safety goggles, the

evils of this practice are now evident to all of us. Accordingly, we have been stressing to our friends in industry as well as our friends among the professions the need for closer cooperation. So many different methods of handling prescription lenses for industrial goggles developed that on July 1, 1940, American Optical Company set forth its industrial goggle policy, clearly stating that no prescription safety goggles would be compounded unless the prescription originated with an ophthalmologist or an optometrist; emphasizing the importance of fitting, re-evaluating and servicing of industrial prescription goggles and setting forth other principles aimed to advance and promote the professional values of industrial eye care.

It is the intention of American Optical Company not only to continue this policy but to expand and elaborate upon it to cover several aspects of the situation which have developed since its publication over seven years ago. An example of this expansion is the new industrial prescription form. This is a product of our experiences and the advice of both professional men and industrial specialists which gives all information necessary in compounding on industrial prescriptions plus the professional man's instructions as to how it is to be carried out.

Guarding workers' eyes from injury is still the sole reason for purchasing safety goggles of the majority of industrial plants in this country; any correction which may be added because the employee needs prescription lenses being secondary to the main purpose of the device—protection.

We consider industry and the professions as customers. Never is the individual employee or patient our customer even though in eye care we feel his is the highest concern. Because a non-focus goggle serves as a guard, we look to expertly trained safety engineers to choose types of eye protection. On the other hand, where both correction and protection are combined in a safety goggle, we welcome participation of the professional man in its distribution. Thus we find a natural divorcement of professional people from the sale of a commodity or packaged goods such as non-focus safety goggles, sunglasses, magnifiers, etc.

However, professional services are absolutely necessary, from our point of view, in handling goggles with focus lenses. There are many arrangements by industry to make professional services available. Frequently professional men are called upon to fit and adjust plano goggles after industry has seen how well safety prescription goggles have been handled by members of the eye-care professions. Industry is gradually becoming aware of the part that professional services play in executing a

goggle program, but a great deal of confusion still exists.

Adding to industry's confusion is the prevalence of practices on the part of some professional people to interest themselves in a sale rather than in rendering professional services. Also some suppliers of safety equipment have no contact with the professions and operate without a feeling of responsibility toward the complete picture of eye care.

As mentioned before, our direct distribution of corrective-protective goggles to industry has a long history. At first it was most difficult to interest professional people in participating in industrial eye care. As corrective-protective goggle demand grew, so did the interest of the professions. The early impression of the professions that industrial prescription goggles were interfering with their practices has changed, for the most part, to an appreciation of a new field for professional services. We feel the surface has only been scratched in this field. We have been pursuing the job of awakening safety engineers and purchasing agents to the need for professional services in spite of the popular misconception of buying glasses.

Education is the key factor in eliminating the present difficulties encountered in distributing corrective-protective goggles to industry. The safety people and purchasing agents have been and are being told every day by our representatives about the professional man's problems. In addition, the professional people will be quick to recognize that industry has its problems also. In order for an industry to pay an invoice rendered, it must have a record of receipt of the goods or services.

With a competent professional man retained as the vision consultant in a plant, there is a minimum of trouble to the manufacturer, the supplier and the management. This is true because the professional man will become familiar with the specific jobs of employees as well as the seeing environment. Thus correct and complete information is supplied on the corrective-protective prescription form. So in many cases, an occupational correction is indicated in preference to a correction to meet the general everyday life situations.

Our interest in the distribution of corrective-protective goggles is in the following principles as laid down in the American plan. First, the individual is the highest concern in eye care. Second, materials are consumed in service. Third, the services themselves are the only things of value in eye care. Our corrective-protective prescription form is a material aid in following these principles and we will only fill this prescription if it is signed and properly filled out by a legalized refractionist.

FURTHER COMMENT ON ACCOMMODATION AND CONVERGENCE WITH CONTACT LENSES*

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In a previous paper[1] an equation was derived which related the difference in fusional convergence (ΔC_f) required with spectacle and contact lenses to the difference in accommodative convergence in the two situations and to the spectacle correction (F). The derived equation was:

$$\Delta C_f = R(\Delta F - \Delta F') - 2FX. \quad (1)$$

In this equation R represents the A.C.A. ratio, ΔF the accommodation with spectacle lenses, $\Delta F'$ the accommodation with contact lenses, and X the distance in centimeters on the surface of the spectacle lens from the major reference point of the lens to the point where the line of sight passes through the lens. In applying this equation, the approximations were made that X remained constant and that 2FX represented the difference in total convergence with spectacle and contact lenses.

Professor Glenn A. Fry and, independently, Mr. Gerald Westheimer, have raised the question as to whether or not these approximations might lead to erroneous conclusions. In order to investigate this matter, a more precise equation for ΔC_f may be derived as follows.

Let 2γ represent the total convergence angle, C_p the proximal convergence, C_t the tonic convergence, C_f the fusional convergence, with spectacles and the same values primed represent the indicated functions with contact lenses, as in the previous paper.

$$2\gamma = C_p + C_t + C_f + R\Delta F, \quad (2)$$

and

$$2\gamma' = C'_p + C'_t + C'_f + R\Delta F'. \quad (3)$$

Subtracting and rearranging gives

$$\Delta C_f = R(\Delta F - \Delta F') + 2(\Delta\gamma), \quad (4)$$

in which

$$\Delta C_f = C'_f - C_f,$$

and

$$\Delta\gamma = \gamma' - \gamma.$$

If P represents the intraocular distance and γ' is expressed in radians,

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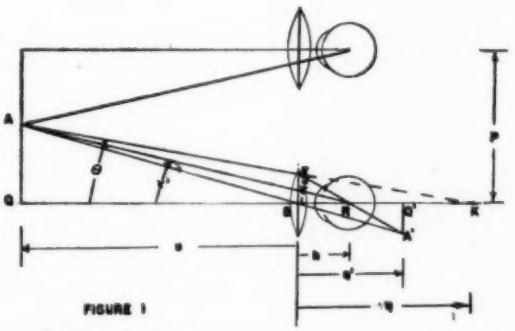

FIGURE 1

it is seen from Figure 1 that

$$2\gamma' = \frac{P}{h\text{-}u} \quad . \tag{5}$$

The value for γ may be determined in at least two different ways.

Fry suggests finding the point K conjugate to the center of rotation R with the spectacle lens, i.e.,

$$\frac{1}{h} = \frac{1}{q} + F.$$

Since

$$\gamma = \frac{BE}{h} \quad , \tag{6}$$

and since from the geometry of Figure 1, it can be seen that

$$BE = \frac{P}{2} \left(\frac{q}{q\text{-}u} \right) \quad , \tag{7}$$

it follows that

$$2\gamma = \frac{P}{(h\text{-}u + Fuh)} \quad . \tag{8}$$

Westheimer[2] suggests another way of deriving Equation (8) using the image Q′ A′ of the plane QA formed by the spectacle lens.

$$\gamma = \frac{Q'A'}{h\text{-}u'} \quad . \tag{9}$$

Applying the image-object equations of first order theory, i.e., $\frac{1}{u'} = \frac{1}{u} + F$ and $\frac{Q'A'}{QA} = \frac{u'}{u}$ to Equation (9) gives

$$\gamma = \frac{\frac{P}{2u}\left(\frac{u}{1+Fu}\right)}{h - \frac{u}{1+Fu}} \qquad (10)$$

which again reduces to Equation (8). Substituting Equations (5) and (8) into Equation (4) gives

$$\Delta C_f = R(\Delta F - \Delta F') + P\left[\frac{Fuh}{(h-u)\ (h-u+Fuh)}\right], \qquad (11)$$

which is a more precise statement of Equation (1) since the aforementioned approximations have not been made.

In order to compare Equation (11) above with Equation (1), Figure 2 represents a plot of the second term of the right hand side of

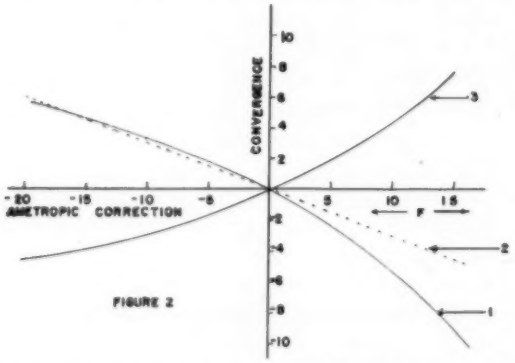

FIGURE 2

Equation (11) in solid line (curve 1), while the dotted curve (curve 2) is a plot of the second term of the right hand side of Equation (1). The ordinates represent values of convergence in prism diopters, while the abscissae are values of ametropic correction at the spectacle plane. These curves have been calculated assuming P = 60 mm., u = 0.3183 meters, h = .025 meters, that is the conditions assumed in the calculation of the curve of Figure 5 of the previous paper.

Comparing these two curves, it is seen that the approximations made by assuming the Prentice rule, (i.e. $\Delta\gamma = -FX$) represents a fairly precise statement of the facts through the range of minus values of F considered. However, in the range of positive values of F these approximations give values which are too small.

Since the ordinate of Figure 5 of the previous paper is determined

by the vector sum of the accommodative convergence (curve 3 of Figure 2) and the second term of Equation (11) or of Equation (1) (Prentice rule approximations), the form of Figure 5 of the previous paper would be changed by the more precise analysis presented here, but the conclusions drawn in the original paper that the values of ΔC_f are negligible with respect to the total convergence for the values of F met in clinical practice would not be altered.

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ABSTRACTS

VARIATION OF VISUAL ACUITY WITH VARIOUS TEST-OBJECT ORIENTATIONS AND VIEWING CONDITIONS. G. C. Higgins and K. Stultz. Kodak Research Laboratories, Eastman Kodak Company, Rochester, New York. J. Opt. Soc. Am., 40 (3), 135-137, March, 1950.

In a previous investigation (J. O. S. A., 38, 756, 1948), the authors had found a significantly higher visual acuity for parallel line grid test objects oriented vertically or horizontally than for the same test objects oriented at 45° or 135°. It had been suggested that this phenomenon could be ascribed to preferential eye movements or damped oscillation of the eyes in vertical or horizontal directions.

These experiments tested the above hypothesis by the simple expedient of illuminating the test-object by means of a flash from a Kodatron Speedlamp for only a thousandth of a second. This flash of short duration precluded the possibility of having judgment influenced by preferential eye movements. Again, the authors found that visual acuity for vertically or horizontally oriented lines was about 20% higher than for the same lines oriented in the 45th or 135th meridian, thus disproving the hypothesis that vertical or horizontal eye movements were responsible for the effect.

The authors also tested the hypothesis that the anatomical location of the fovea, (which is not on the optical axis of the eye, being located approximately 5° temporal to and $3\frac{1}{2}$° below the position pole of the eye), might influence the visual acuity in different meridians. However, their data gave no conclusive evidence of the applicability of this hypothesis.

BERNARD ROSETT.

A PROGRESS REPORT ON PLASTIC OPHTHALMIC LENSES*

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The subject of plastic ophthalmic lenses, of course, is not new. Many have discussed it before, and very ably. Due to the many misconceptions concerning plastic lenses, however, it might be well to examine, at this time, many of the factors affecting this lens device, and also to present a progress report on its development to date.

First, let us examine some of the factors concerning the basic material—the plastic itself. The concept held by the lay public and many of those in the professions is that plastic lenses should be simple to make and, of course, inexpensive. Nothing could be farther from the truth.

Actually, the best type lens is not a plastic but is a thermosetting resin. The word "plastic" is developing into a synonym for a cheap material.

The gradual development of the plastics industry may be enumerated in part as follows:

1. General use of natural resins, gums, shellac, ceiling wax.
2. Production of cellulose nitrate—the original ivory substitute (Schoenbein, 1846).
3. Demonstration of industrial use of cellulose nitrate when plasticized with camphor (Hyatt, 1869).
4. Discovery of less flammable cellulose derivative—cellulose acetate (Schuetzenberger, approximately 1870).
5. Isolation of new type of plastic—casein from cows' milk (Childs, 1885) and application to industrial use (Spitteler, 1904).
6. Molding of phenolic resins (Baekelend, 1909).
7. Synthetic glass from urea-formaldehyde (Hans, 1917).
8. Industrial use of urea resins (about 1927).
9. Rapid advance (1929-1949).

Urea formaldehyde glass is not satisfactory. The resin absorbs water and the surface becomes dull. The resin is not stable and continues to age with resulting strains, cracks and disfigurements.

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In the 1940's, two of the largest American manufacturers of glass became very interested in glass substitutes of the resinous type. The Pittsburgh Plate Glass Company spent about nine years, with as many as 25 highly skilled technicians, working on this problem. Over 100 resins and their combinations were synthesized and evaluated. The result was the selection of CR-39 as the resin with the most of the necessary properties.

The Corning Glass Works looked in another direction. The element silicon is located just above carbon in the periodic table of elements and in the same group. Its chemistry, therefore, is very similar to that of carbon. For this reason and because of the presence of silicon in glass and the fact that fused silica is the hardest glass known, they reasoned their research should lie in this direction. This work resulted in the formation of the Dow Corning Corporation. During the course of their work many very interesting silicones were produced which had wide fields of industrial application but to date no substitutes for glass have been put on the market. Many very hard resins have been found but because of technical difficulties and lack of optical qualities, their uses have been restricted to the field of paints and lacquers.

In 1940 the Polaroid Corporation was commissioned by the National Defense Research Committee to develop resins suitable for use in military optical instruments. One hundred and thirteen compounds were synthesized and studied thoroughly. Seven methods of synthesis were tried. Cyclohexyl methacrylate and styrene were found suitable. Both of these materials were linear or thermoplastic having the undesirable properties of:

1. High coefficient of expansion.
2. Low softening temperature.
3. Lack of hardness.

Cross-linked resins were also developed by Polaroid, through the use of special syntheses, including ethylene dimethacrylate, and allyl methacrylate. The cross-linked polymers were not considered desirable because the fabrication of lenses from these materials was very difficult with the techniques that were developed by them. The cross-linked materials, however, showed the following desirable properties:

1. High hardness.
2. High softening temperature.
3. High resistance to chemicals and solvents.

Recognizing the difficulty of working with cross-linked polymers the National Defense Research Committee established a research program

at the California Institute of Technology for the purpose of increasing the scratch resistance of the more easily worked linear plastics by means of hard coatings. The most satisfactory results were obtained with the use of silicon tetra-chloride in the presence of ozone. Aluminum oxide films and magnesium fluoride films were also tried with poor results. It will be noted, however, that even to date the best method found at that time is not feasible on a commercial basis.

In order to be satisfactory as a substitute for optical glass a resin must have the following properties:

1. Optical homogeneity, and high light transmission.
2. Low dispersion to avoid chromatic effects.
3. Index as high as possible to minimize curvatures required.
4. Ease of fabrication to permit economical cost.
5. The fabrication process must be capable of repetition to insure consistent results.
6. High surface hardness and abrasion resistance to allow competition with glass in wear.
7. High impact resistance and notch resistance so that a great improvement over glass in these respects is obtained, thus giving a greatly increased safety factor.
8. High flexural rigidity.
9. Low change in optical and physical properties over large ranges of temperature.
10. High stability and low aging effect, e.g., discoloration, crazing, cracking, etc.
11. Easily prepared and inexpensive raw materials to permit economical cost.
12. Very low weight. Most resins considered for use already show this advantage and are about half the weight of crown glass.
13. High resistance to attack by solvents, reagents, etc.

During the work at Polaroid many of the optical properties of resins were analyzed. It was found that cyclohexyl methacrylate had an n_d of 1.50645 and a Nu value of 56.9. For styrene n_d was 1.59165 with a Nu of 31.0. Columbia Chemical resin CR-39 has an n_d of 1.50398 and a Nu of 57.84. Methyl methacrylate has an n_d of 1.49.

During the work at the California Institute of Technology it was necessary that methods for evaluating scratch resistance be established. Several methods were developed:

1. Diamond point scratch hardness tester.
2. Wear tests involving abrasion against cloths.
3. The Taber Abraser involving abrasion with abrasive wheels.

The Taber Abraser has recently been adopted by the American Society for Testing Materials as the accepted standard method for abrasion testing. By means of this test it was determined that CR-39 required 15 times as many cycles with the CS-15 pad as Lucite to obtain equal amounts of abrasion.

Recently the Univis Lens Company has been investigating the use of the various minerals of MOH's scale of mineral hardness for scratch resistance testing. MOH's scale sets talc as the softest mineral, number 1, and diamond as the hardest mineral, number 10. Qualitatively we have found that CR-39 is not scratched by gypsum which is number 2, but is scratched by calcite which is number 3. Glass is not scratched by number 4, which is fluorite, but is scratched by apatite, which is number 5. Methyl methacrylate, polystyrene and cellulose acetate are scratched by talc, which is number 1. These results cannot be construed as being directly quantitative because diamond is many more times harder than talc than the numbers 10 to 1 indicate. The periods within MOH's scale have no regularity, the difference between 3 and 4 in actual value has no relationship to the difference between 4 and 5 or 6 and 7. Nevertheless each numbered mineral is harder than a mineral with a lower number.

The properties of cross-linked polymers and linear polymers differ fundamentally because of a difference in actual molecular structure. A polymeric molecule, regardless of whether cross-linked or linear, consists of a repetition of connected molecules. In the case of linear polymers the monomer molecules are connected in chains, to some extent linear in nature. These materials are thermoplastic which means that they can be deformed under conditions of elevated temperature. A large piece of such material may be assumed to be made up of many of these polymeric molecules interwound much in the same way as the fibers in a piece of cotton thread or as the fibers in a piece of felt. Just as in the case of textile fibers, these polymeric molecules are acted upon by solvents which first cause the molecules to become partially separated, resulting in swelling, and finally causing the molecules to become completely removed from each other, resulting in solution. To carry this analogy further scratching forces will also cause separation of the molecular fibers; this makes this linear type of material more easily scratched than the cross-linked materials as will now be seen. Methyl methacrylate, a

linear material with great impact strength, has been tried for ophthalmic lenses but has been found to scratch too easily.

The monomeric molecules of linear polymers have two places on each for use in becoming attached with each other. Think of them as the links in a chain. The cross-linked, or thermosetting resins, have more than two points for use in becoming attached to each other: the cross-linked polymeric molecules are therefore developed much in the same manner as a three-dimensional screen. A piece of this type of material, even of considerable size, might well consist of a single molecule. The action of solvents therefore, on this type of material, differs from the action on the linear resin. Not having the fibers upon which to work the solvents must therefore act by penetrating the interstices of the three-dimensional chain and cause an actual disruption of the bonding forces within the molecule itself. This, of course, is accomplished with some difficulty. The action of scratching agents is reduced because of the same condition: they must cause some disruption *within* the molecule to result in scratching the cross-linked resins instead of *separating* the molecules as in the case of the linear polymeric fibers. Actually scratching of cross-linked resins, to some extent, includes the separation of the molecules as well as the disruption of the molecule itself. The cross-linked material can be raised to an elevated temperature without deforming as would a linear material. It cannot be pressed or moulded while hot and an article to be made from it must be produced by polymerization of the monomer in the final form desired.

Obviously the impact resistance of a resin is also dependent upon its structure. The linear resins will show, generally speaking, a higher impact resistance than similar cross-linked resins. This may be true because the elasticity within a given linear polymer molecule will be able to assert itself to a greater extent than in the case of the more rigidly constructed thermosetting polymer molecule. This condition is further demonstrated by the fact that increased scratch resistance can be obtained by manipulation of the molecular structure to obtain greater rigidity, but this alway seems to give a decrease in impact resistance. This last stated circumstance is one of the limiting factors in obtaining resins more nearly approaching glass in hardness without a sacrifice of impact resistance.

It has so far been found impossible to develop a resin having all the desirable properties in the highest degree—from this material could be made the perfect plastic lens. If some properties are developed to the optimum, then it is found that others fall below acceptable requirements.

Many attempts have been made to effect a compromise by copolymerizing different proportions of various resins each with special properties. The results have not yet been entirely successful and the fabricating techniques are difficult owing to the varying amounts of shrinkage which occur on polymerization as well as other effects. It is felt that these difficulties might be overcome. Another direction in which work is proceeding is to continue the work done during the war on hard coating a resin which is good in all other respects. This looks very promising.

Lenses are at present being made on an experimental basis from the best material at present available, a cross-linked resin. Techniques have now been developed so that they can be produced having equal or greater superior properties to those of glass in all respects except that of abrasion resistance. A resin with the surface hardness of glass has not yet been produced and therefore these new lenses will scratch more easily than glass. We now have to determine whether the greatly increased comfort, safety and other desirable factors are sufficient to compensate for the fact that they must be replaced more frequently than glass. The perfect plastic lens cannot yet be made—it will be one day. How near that is will depend on the direction and speed taken by basic research, probably along the lines indicated below.

The presently known area of polymer chemistry wherein lie the resins having the necessary optical and other characteristics has been thoroughly investigated. The materials which are now available represent the best results obtained to date. Any improved materials must come through the opening of new areas of polymer chemistry and even basic research has not yet disclosed these areas. There are several possibilities about which not too much is yet generally known and these include resins in which some of the carbon atoms are replaced by silicon, titanium, germanium or even, possibly, selenium. These areas are suggested again because of the presence of these materials in inorganic glasses. Only very little work has been done in the preparation of varied types of metallic organic compounds and most of that has been on the silicon materials. It can be readily seen that these fields of investigation are as large as the entire field of the present organic chemistry. Much fundamental work remains to be done before any practical products can be developed for industrial use from these new areas and the techniques developed for fabricating them into high quality ophthalmic or instrument lenses.

THE FIELD TEST

Of interest will be the details of a recent field test conducted by

The Univis Lens Company.

2,500 pairs of lenses, made of thermosetting resin, were made covering a wide range of powers, including both 1st and 2nd division sphero-cylinders as well as plain spheres.

Several test areas were selected in order to provide as wide a range of conditions as possible. Among these were Ohio State University, Northern Illinois College of Optometry, The Univis Lens Company factory (factory and office workers) and several large dispensing opticians.

Special edging equipment was designed to provide the laboratory technician an accurate and speedy method of edging the lenses to proper size and shape.

Questionnaires were developed for the technician, the dispenser and the patient. Among questions asked the technician were:

a) In what condition did you find the lenses when first starting to work on them?
b) Did you damage them during the processing operation?
c) Did you encounter any difficulty in inserting the lenses in plastic frames, and if so, what were they?

The dispenser was also asked several questions. Among them:

a) What was the patient's reaction to the idea of wearing plastic lenses?
b) Did the higher price affect their sale?

The prescribing doctor was also consulted regarding his attitude to plastic lenses before any lenses were dispensed.

Arrangements were made to have the patients return several times during the three-month field test period to determine the condition of the plastic lenses in so far as scratches and other surface defects were concerned.

After the three-month field test was completed, all questionnaires were gathered in and results were tabulated. Some conclusions drawn from these results were as follows:

PROCESSING:

a) General quality of the lenses was superior to glass in so far as power, thickness and surface quality was concerned, at the time of delivery to the dispenser.
b) Edging was easily accomplished, but insertion in a plastic frame was difficult and skill had to be developed by the technician.

c) Drilling and mounting in rimless mountings presented no problem.

d) Care had to be used in processing to avoid damage as careless shop handling had a tendency to scratch the surface.

DISPENSING:

e) Most patients were willing to try the lenses and did not object to the increased price (about 15 per cent).

f) Patients were reasonably willing to cooperate in the test.

PATIENT REACTION:

g) The small degree of scratching encountered after three months wearing period was not objectionable. Patients either had not noticed the scratches or didn't particularly care.

h) Most patients were greatly pleased by the lighter weight (less than 50% that of glass). Several rimless glass wearers were particularly impressed.

i) In general, patients did not want to be bothered using the special cleaning wax and wiping cloth provided.

j) Their psychological reaction to having lenses that would not break easily was good. Where lenses were fitted to children, the parents were especially pleased over the safety factor, but in one or two cases, later expressed the opinion that the replacement cost might be too high as the children had a tendency to play harder and badly scratched, but did not break, their lenses, in a short period of time. Adults were pleased with the non-breakage factor, but not to the point that this point would be a major factor in causing them to purchase plastic lenses.

k) In answer to the general question, "If plastic lenses were available to you as a regular thing, would you buy them?", the general opinion was apathetic and most patients indicated that they "might" be so inclined.

l) It was also determined in questioning the practitioners regarding plastic lenses for their patients that there was a definite lack of enthusiasm on their part.

CONCLUSIONS

Several conclusions were drawn as the result of the field test described above:

1. Techniques will have to be developed to insure easier handling and more efficient and accurate workmanship in the laboratory.
2. There is no ready market for plastic lenses on the part of the

public. The public, at this point, does not appear to be ready to enthusiastically accept the idea of plastic lenses over glass.

3. The practitioner is not yet ready to accept plastic lenses as an improvement over glass.
4. Price does not appear to be a deterrent. The public appears to be willing to accept plastic lenses for as much as 15 per cent more than glass, cost-wise.
5. Improvements must be made in surface hardness and aging quality.

The writer hopes that the impression gained from this report is not a pessimistic one as to the possible future of plastic lenses. On the contrary, it must be noted that active research is being done and weaknesses have been discovered. None of these weaknesses is unsurmountable. The several companies who are interested in plastic lenses are continuing their basic research and already have improved the product.

Certainly plastic lenses have a place in the future, and present day products are vastly improved over early types. The day will surely come when plastic ophthalmic lenses in white and absorptive shades, in all ranges of single vision and multifocal lens types will be available and will offer the practitioner a lens device vastly superior to glass which will effect a more efficient and comfortable means of correcting eye anomalies by means of external spectacles.

Appreciation is hereby expressed to The Univis Lens Company, the Polaroid Corporation, the Dow-Corning Company and others who contributed data to this report.

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ABSTRACTS

A REVIEW OF THE LITERATURE CONCERNING THE DEVELOPMENT AND CONCEPTS OF INDIVIDUAL VISION TESTING. A. L. Paul. Alumni Bulletin of the Pennsylvania State College of Optometry. 3.12.1-7. 1950.

The author reviews the development of visual screening apparatus now in use in industry and schools. The Keystone telebinocular, the American Optical Company sight-screener and the Bausch and Lomb Optical Company ortho-rater are all in wide use. He presents the advantages and limitations of each as well as the scientific principles employed by each instrument.

C. C. K.

THE CLINICAL ASPECTS OF RETROLENTAL FIBROPLASIA WITH REPORT ON ONE CASE*

I. Irving Vics†
Albany, New York

Current statistics show that each year about 432 babies in the United States become blind shortly after birth. This figure is based on statistics supplied by the Children's Bureau of the United States Department of Labor on the basis of 3,600 premature births yearly.[10]

With modern advances and greater skill developed in medicine, a greater survival of premature infants has been achieved. Along with this has been observed a greater incidence of blindness in the prematurely born. Seven years ago, Dr. T. L. Terry of Boston discovered that the pathology, among those prematurely born, which had been incorrectly diagnosed several times as retinoblastoma (with subsequent enucleation) was in reality a condition which he reclassified as retrolental fibroplasia.

This greyish mass of tissue behind the crystalline which formed from a few days to several months after birth, was not the glioma transillumination seemed to indicate. It remained for Terry to make a careful study of this syndrome, and to rename and reclassify it. What years before was also diagnosed as persistent tunica vasculosa lentis, he now called a "fibroplastic overgrowth of the vascular sheath," and subsequently "RLF."

Terry's contribution consists of having made an intensive study of conditions allied to persistent tunica vasculosa lentis. Many of these conditions, unassociated prior to his research, he found could be considered as one disease entity. This entity consists in primary and secondary changes related to: (1) persistence of all or part of the hyaloid-artery system; (2) growth of embryonic connective tissue behind the lens; (3) persistence or overgrowth of fibrillar structure of vitreous. Part of the inquiry was devoted to following in detail the development and regression of the hyaloid-artery system. Extensive laboratory investigations were made in working on the problem in order to clear up the many conflicting statements that had existed in the literature.

*Read before the annual meeting of the American Academy of Optometry, Cleveland, Ohio, December 13, 1949. For publication in the May, 1950, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Fellow, American Academy of Optometry.

In the summary of Terry's paper in 1942 are set forth 13 conclusions based on his findings which stand as a tribute to his skill as an investigator.

Since Terry's[9] preliminary report in 1942, many men have entered the field in the research of what might be a new disease occasioned by extreme prematurity, or an old one in a new guise. At present, investigations are going on in New York City, Cleveland, Boston, Baltimore, and other parts of the country.[3, 4, 5, 6, 9, 14]

One of the papers offered in furthering the research on the problem was presented by Reese and Payne[6] of New York City in 1946. Their contribution was essentially the classification of the disease into four types, and renaming it once again as a "hyperplasia of the primary vitreous." On this latter point Terry and Reese differed in the discussion that took place after the presentation of the latter's paper. Interestingly enough, the term retrolental fibroplasia appears consistently throughout the Reese paper.

Reese and Payne submitted a group of 50 cases in the tabulation of their findings. These, however, represent varying age levels. The group is composed of one case having RLF since 1930, one since 1932, one from 1933, one in 1935, etc., until 1943, when they found nine, 11 in 1944, and three in 1945. The 50 cases further break down into 30 that were premature births, and 20 full term births. Of these RLF was bilateral in 35, and unilateral in 15.

The very scholarly essay that these men proffer is supported by eye sections and photographs illustrating their typings and delving into the microscopical, etiological, and functional manifestations of the condition. There is, however, no mention of refractive errors or refractions made.

In advancing their theories as to what occasions the pathological disturbance, different men have come forward with several explanations, each of which was subsequently discounted, or accepted with reservations pending further study. Among these have been the precocious exposure to light while in the incubator[8], maternal infection during pregnancy[6], possible absence of male or female hormones[8], and lack of vitamin E[5].

Surgical intervention has been aimed at improving the condition with no apparent success. Among these operations have been efforts to seal off the hyaloid-artery with diathermy, with no success;[11] trying to establish a new vascular connection between the episcleral vessels outside the eye with the ciliary body.[13] This proved of doubtful value. Removing the lens substance and making a vertical cut in the retrolental tissue, with only some beneficial results.[14]

In addition to operative procedures, irradiation with x-ray[6] has been tried, here again with poor results. Mydriatics have been used in the attempt to put the iris at rest and to break up possible posterior synechiae, and as a preventive measure at birth.[13]

To counteract secondary effects of the disease, miotics, and surgery have been used to alleviate the onset of glaucoma. It has been observed that glaucoma in this particular pathology acts differently than in other cases.

Generally all seem agreed that a failure of the aqueous to form or accumulate in normal amounts is responsible for failure of the eyes to grow.

One writer learned that in several cases of Caesarean section the disease did not develop.[8] Another finding showed a significant ratio of eight males to five females having RLF.[8]

In listing representative symptoms of RLF, feeblemindedness or mental retardation was included as being prevalent in children having this involvement. This was challenged by Runge,[8] who said that this was open to question. It has been the writer's observation in the cases that we have seen, that each of these children possessed a good or better than average intelligence.

Further comments disclosed that in a few cases there was a partial retrogression of the opaque connective tissue taking place, where no treatment had been instituted, but withal these eyes did not develop normally.[14]

Those who have been doing work with subnormal vision have met with RLF. It has been variously labeled congenital cataract or persistent vascular sheath. In the greater majority of cases nothing could be done for this group of patients, since there was no vision to begin with. This was especially true when the patient came in with a pure white covering of the pupil, and where the pathology was of long standing.

It was the thought years ago to return letters of inquiry to the senders, where congenital involvements or bilateral RLF were concerned (where there was no visual acuity), to denote that no help could be given such patients. Recent events, however, have given rise to a new approach, as the following case report will indicate.

The patient, M. K., female, was first seen at 17 months of age. The first introduction to this case was by a letter from the mother, pleading for help for her child. This letter also told of the baby having been taken to various eye men, all of whom had diagnosed the case as RLF, and that the baby had been blind from birth. Our reply asked

the mother not to bring the child in, unless she demonstrated some degree of vision. A return letter told of the semi-annual trip to the attending ophthalmologist who suggested that the child might have some degree of vision in one eye. This seemed sufficiently encouraging to invite the parents to bring the patient in. At the time of the first examination, April 25, 1949, tests divulged a lack of vision. Ophthalmoscopically, in the left eye, the bound-down pupil of about 1½ mm. was irregular in shape and completely covered by a whitish sheath, almost no anterior chamber, no reaction to light and the fundus not visible. The right eye had a pupil of about 4 mm., reacting to light and a good color reflex was obtained from the retina. The lens seemed clear, though there were manifestations of what seemed like remnants of the hyaloid. The periphery of the lens showed the typical elongated ciliary fibers of RLF. The fundus could not be seen clearly due to the patient's continual shifting and excitement. The eyes were also enophthalmic. The retinoscope revealed a surprising element. This reading was recorded as +12.00 D. sph. in the right eye. In addition there were the usual searching movements and squint (exotropic in this case). In the subjective part of the examination attempts were made to elicit some visual response, but these failed. A correction was made up with a +8.00 D. sph. O. D. and the patient allowed to wear this for three weeks.

As is usual with babies, there were attempts to remove the spectacles, but persistency on the part of the parents forced the patient to wear the correction the greater part of the time.

The patient was next seen three weeks later. At this time, arrangements had been made for the mother and child to stay in Albany for one week. The patient was seen for one hour in the morning, and one hour in the afternoon each day, during which time rhythmical stimulative exercises were started in order to create visual awareness.

The Plateau spiral was used with a colorful pinwheel attached to the outer rim. A photoflood light equipped with flasher was aimed at the spiral, and the patient's attention directed to the spinning disc. Interestingly enough, the searching nystagmus gave way to quiet observation and it was seen that the patient made attempts to follow the pinwheel around with her eyes.

To create audio-visual conditioning, a telegraph key connected to a high frequency buzzer was arranged so that when the child pressed the key a photoflood light would be turned on. The pleasing note of the buzzer was appealing and the patient enjoyed this game. Here again it was interesting to observe her turn her head in the direction of the light, when it was shifted from one position to another.

One device that was constructed, consisted of a board about five feet long on which had been fastened seven lamp sockets. Different colored bulbs were placed in each socket, and each light was actuated by its own flasher button, so that a mosaic of light at irregular intervals was achieved. This was simply placed in front of the child, who would watch the light flashes. Reaction to this was good, holding the child's attention for a longer period than expected.

A series of balls of varying sizes, ranging from a huge balloon-like ball to a colorful tennis ball, were used in a game of "catch" by rolling the ball on the floor toward the child.

Colorful alphabet blocks were used to develop a visual response to the tactile sense. Peg boards were also used for the same purpose. Flashing, moving objects, and scenes, emanating from the tachistoscope, rotoscope, and stereo motivator, were also utilized.

During the week the child was refracted again and the prescription changed to O. D. +12.00 D. sph. In addition a calobar absorption fitover was supplied to be worn outdoors and even indoors if necessary. The fitover seemed to bring a measure of relief.

One of the common movements made by infants with RLF is to cover their eyes with their hands, or to bury hands and face on a chair, or shoulder of the person holding the baby. With this patient, it was observed that she did not do this while glasses were being worn, but did revert to this practice the moment the glasses were off the face.

With the spectacles off, the eyes were half shut and the child looked sleepy. With the glasses on, the eyes were alert and wide open. Even the searching movements seemed to stop while the correction was being worn. The right pupil also reacted to light much better when the reaction test was performed.

At the conclusion of the week, mother and patient left for home. A complete schedule of exercises to be done at home was outlined to the mother. This she promised to follow faithfully. In this the mother was actually over zealous.

The next period spent with the patient was at her home three months later. At the invitation of the father to spend a week end "to see what we are doing," much more was learned than could be done in the spasmodic visits to the office. The chance to observe the patient in her own familiar surroundings was an opportunity that proved very well worth the time and effort involved.

The first session was spent in rechecking findings. While these did not seem to have changed it was observed that the nystagmoid searching movements were slower and more deliberate. Both retinoscopic and

ophthalmoscopic findings were the same, though the RLF might have seemed to be a bit more grey. It was easier to work with the patient and for the first time she did not bounce about or shy away while the inspection was going on. Much more time was spent in this procedure than had been done heretofore.

The child, at home, proved to be a very happy, healthy baby. She could sit for great lengths of time in her teeter-totter swinging back and forth, singing to herself, or smiling quite often, when her imagination so indulged itself. This was pointed out and stressed to the mother, who was so "full of pity" for her baby. Still in the process of learning to walk (at 22 months), the baby toddled from chair to chair and then to the spinet piano. Here she demonstrated a remarkable talent. Her father struck a chord of two notes at the opposite end of the piano. The baby then ambled over and found and repeated the exact chord; either two white keys, a black and white, or two blacks, were all repeated by a tone detection process. She could also play simple nursery tunes with remarkable ability. There was, however, no visual act involved.

Feeding time had never offered any problem, the child eating with relish and appetite and stopping when she had had enough. Sleeping time, however, did bring a surprising element not divulged during the visits at the office. For as long as she could remember, the mother told of the child not going to sleep before ten or 11 o'clock and then sleeping very fitfully, waking up about five or six times during the night. This in contradistinction to her afternoon naps, when she slept soundly from two to three hours. It was therefore decided to try the Saks[16] technique, and two small 7½ watt bulbs were placed in the wall brackets over the crib. That night for the first time the baby slept through the night. This process was repeated the second night and again a restful night was enjoyed by the patient, mother and father. It was then suggested that this be kept up for the next month or two.

In the home, the patient's playroom had been turned into a visual training area, a duplicate of the Plateau spiral, as well as other devices used in our office, had been made by a neighborhood mechanic. Here time was spent in the same fashion as at the office.

Before leaving, a definite statement was made expressing belief that the child now had about from two to four per cent visual acuity. This estimate was based on the writer's experience four years ago when he reduced his own vision to two per cent of normal and made observations over a period of three and one-half hours while in this condition.[15]

As is usual in sub-normal vision cases, there are many questions that are asked, each of which requires a tactful, direct answer. One of

these questions posed by the patient's mother was whether telescopic spectacles would now be prescribed. The reply was, that it would be better to wait until the child had a greater visual awareness, that a year or two later these might be beneficial. This suggestion had also been given to three other cases of similar nature.

To aid the parents of these children, who write or call at the office, the optometrist must prove himself adept in the social services, for his work must include all phases of education and skill in the handling of these people. It is parents, perhaps more than the children, who need proctoring in their attitudes in working with, and aiding their child. The assumed feeling of guilt that they are responsible for their child's condition requires tactful redirection, and here the optometrist can be of great help.

It is in this spirit that this report is being made. It is hoped that an exchange of findings with other optometrists doing work with RLF, may elicit new suggestions to be followed in aiding those patients with this disease.

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ALBANY, NEW YORK.

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WELCOME TO A. O. A. CONGRESS AT MINNEAPOLIS

Members of the American Optometric Association, their families and friends—delegates—and exhibitors—we welcome you to Minneapolis, the Congress city for 1950. The A. O. A. meets in the flour capital of the world in its 53rd annual session and we of Minneapolis and the Upper Midwest are pleased to be hosts to this great optometric organization.

In coming to Minnesota for the Congress you will have the opportunity of visiting a fine northern state. A state rich in early associations and young enough to look to the future with optimism.

You will find a happy balance between agriculture and commerce —manufacturing and pleasant urban and rural life so typical of this region. You will meet tolerant people who believe in the advantages

of 20th century civilization and who have these advantages and enjoy them to the utmost.

You will meet people who generally understand and appreciate good optometric professional service, too—as they have enjoyed it for a long time. In fact, that generation of Minnesota men and women who were making state-wide policy decisions just 50 years ago, agreed that statutory regulation and registration of optometrists was the proper thing to do for the public welfare. At the 1901 session of the Minnesota legislature the world's first regulatory optometric act was passed. This first optometric law was patterned largely after the similar act regulating the practice of medicine.

During the intervening 49 years optometry in Minneapolis has made progress and optometrists here are recognized as professional specialists in their chosen calling.

And so—you, too—as our optometric guests—will be accorded the gracious hospitality shown professional people. We welcome you to the North Star State, knowing the Congress and all it affords will make your trip to Minneapolis one long to be remembered.

CAREL C. KOCH

ON THE SUBJECT OF PRESSURE FROM ADVERTISERS

At the recent meeting of the Academy at Cleveland, the question was raised as to whether pressure is ever exerted by advertisers to prevent this Journal from carrying out an Academy editorial policy. Our immediate answer was that we had never experienced pressure from any one of our many advertisers and we felt that, as a whole, the advertising and administrative people representing these firms with whom we deal had been most careful to avoid this very thing.

During the winter just passed a meeting was held of technical and trade publications. Here editors and publishers reviewed common problems and the same question was raised. Several speakers made it clear that it was the duty of a publication to make a fair profit on its business. These speakers stressed the point that a really free press serving a profession or industry is a financially independent press which makes sufficient net profit from its operations to be able to print articles and reports, and take editorial positions without fear of temporary withdrawal of support of either advertisers or readers.

The technical editor is in the same dilemma as all other editors. Occasionally in the interest of his readers he must take a position a

variance with the policies of one or more of the firms from which he obtains some of his revenue through the sale of space.

In other fields, we have on rare occasions heard of pressure being exerted on publishers by advertisers to prevent some publication from carrying out its policies. In the writer's 27 years as editor of this Journal, we have never experienced pressure of any sort from an advertiser or prospective advertiser. This is a fine record and one which speaks well for the leaders of the optical industry who are doing an excellent job in serving optometry, ophthalmology and opticianry.

CAREL C. KOCH

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

LOCAL CHAPTER ACTIVITIES

SOUTHERN CALIFORNIA CHAPTER

Remedial reading and cybernetics* were the two discussion topics of the April meeting of the Southern California chapter. Dr. Maurice Dalton narrated a movie film on the development of a remedial reading program, and Dr. George Fitzgerrell, staff member of Los Angeles College of Optometry, spoke on the subject of cybernetics.

MICHIGAN CHAPTER

New officers of the Michigan chapter are, Dr. R. H. Tichnor, St. Joseph, chairman; Dr. T. R. Bell, Alpena, vice chairman, and Dr. J. C. Kehoe, Flint, Michigan, secretary-treasurer. Elections were held on April 13 at the Roosevelt Hotel in Lansing, Michigan.

ARKANSAS CHAPTER

Election of officers was held at the April meeting of the Arkansas chapter. The following men were voted into office, Dr. W. H. Dowdell, Malvern, president; Dr. Charles H. Brown, Little Rock, vice president; Dr. O. H. Johnson, Jonesboro, secretary-treasurer; Dr. C. G. Melton, Fayetteville, executive council member.

*A new science dealing with the newly-developed "thinking machines." Defined broadly as the entire field of control of communication whether in the machine or in the animal.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items for general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

A. O. A. CONGRESS TAKES SHAPE

"Where's a good place to eat?" is about the first question delegates to the American Optometric Association annual congress will be asking when they arrive in Minneapolis on June 23rd. We can answer that question right now, and save convention goers valuable time and their good dispositions. Listed below are restaurants where both tourists and Minneapolitans have found good eating. Limited space prevents us from giving many details, but we are mentioning dishes we can especially recommend.

Flame Room, Hotel Radisson (convention headquarters). For a never-to-be-forgotten meal, try the Flame Room's lobster thermidor, with tiny, crisp shoestring potatoes. Dancing. Floor show. Liquor served. Open Sundays for "brunch," only.

Viking Room, Hotel Radisson. Ideal place for lunch, dinner, or an after-meeting snack. Specialty—Russian salad.

Sky Room, Dayton's. Next door to Radisson. This new fourteenth story restaurant offers fine food and unusual atmosphere—a skyline view of Minneapolis while you dine. Dayton's also has two other fine restaurants on the same floor, the Tiffin Room and the Oak Room. No liquor.

Wedgwood Room, Curtis Hotel, 10th Street and Third Avenue South. Famous for its "Parisian" luncheon featuring a parade of waitresses serving unique salads and hot dishes. Dinner music by Dick Long. Liquor, except on Sundays. Six blocks from convention headquarters.

Normandy Kitchen, 405 South Eighth Street. A favorite for those who prefer a dining room where liquor is not served. Quiet, attractive dining room. Famous for good steaks at a reasonable price, and "King Henry VIII" giant hamburgers. Ideal place if you wish to take children along.

Charlies Cafe Exceptionale, 701 Fourth Avenue South, four blocks east of Hotel Radisson. Don't let the exterior of Charlie's fool you. It looks like a cross between a mortuary and a church, but inside it is one of Minneapolis' finest cafes. Plush, suave atmosphere. Wide

variety of food. Noon specialty, a "Cedric Adams" sandwich—rich cheese and turkey combination. Good steaks. Liquor. Closed on Sundays.

Harry's Cafe, 74 South Eleventh Street, four blocks south of the Radisson. The food here is substantial and includes steaks, chops and seafood. Liquor served. Closed Sundays.

Freddie's Cafe, 605 Second Avenue South. Two blocks east, one south of the Radisson. Liquor served. Freddie serves one of the best lunches in the Twin Cities. Quiet atmosphere, no music. Wide variety of food. A favorite of all who dine out in Minneapolis. Closed Sundays.

John's Place, 28 South Sixth Street. A second floor Chinese restaurant. Excellent food. American food if you wish. Liquor served. A block north of the Radisson.

Nankin, Chinese restaurant a couple of doors away from the Radisson on 15 South Seventh Street. Tempting and unusual oriental cuisine. Liquor served. Closed on Sundays.

Schiek's Cafe, 45 South Third Street. One of Minneapolis' oldest and most famous restaurants. Noted for fine German food, as well as steaks and lobsters. Brown beer a specialty. About five blocks north of the Radisson. Floor show. Closed Sundays.

Dutro's Sea Food Restaurant, 828 Hennepin Avenue. No special atmosphere, but good seafood. Specialty: "Pieces of Eight," a dinner featuring eight varieties of seafood. Liquor served. Closed Sundays. A block and a half from Hotel Radisson.

Cafe di Napoli, 816 Hennepin Avenue. Specializes in Italian foods. Liquor served. Next door to Dutro's on Hennepin Avenue.

Minnesota Terrace, Hotel Nicollet, Nicollet and Washington Avenues. Patronized by tourists and Minneapolitans alike. Name bands, floor show, dancing. Excellent food. Reservation usually necessary. Five blocks north of Radisson. Closed on Sundays.

Stouffer's, 89 South Seventh Street. Block east of Hotel Radisson. Medium priced luncheons and dinners. Tea-room style food, temptingly prepared.

Minneapolis is all set to welcome Congress delegates and from the looks of plans drawn up by Dr. Roger Lindquist and his Congress General committee, it promises to be a pleasure packed event! This writer sat in on the General committee meeting while final plans were being made, and was impressed over and over with one thing in particular. No matter what problem came before the committee for discussion, first consideration was for the welfare and entertainment of con-

vention delegates and guests. Every hour of entertainment, education and business has been planned for their benefit.

Educational speakers have been chosen with a view toward giving up-to-the-minute developments in the major phases of optometric work. Dr. Eugene Freeman, dean of Chicago College of Optometry and renowned contact lens specialist, will speak. The dean of Los Angeles College of Optometry, Dr. Henry Hofstetter, will bring delegates up-to-date on problems and new developments in optometric practice. Representing the research field will be Dr. Thaddeus Murroughs who has been working on the problem of strabismus at Chicago College of Optometry since September, 1949. Industrial vision will be the topic of Dr. Richard Feinberg, dean of Pacific University's School of Optometry.

Negotiations are also under way for an A. O. A. sponsored television program over WTCN on which Dr. Carl Shepard of Chicago will give demonstrations and a talk on visual care. Tentative plans are to have a "television participation" session also, in which members of the audience can see themselves televised. (We hear this is sometimes a humorously shocking experience!)

Additional speakers for the educational program will be announced by Dr. Marvin Halgren, educational committee chairman, as final acceptances come in.

Other plans for the comfort and pleasure of delegates and guests:

Registration chairman Lorne Holmes is making every effort to avoid "registration lines" the opening day of the convention. Anyone planning to go can help by registering in advance for both the convention and hotel accommodations. Room reservations are being handled by Dr. Arthur Tillisch, 615 West Lake Street, Minneapolis.

Musical entertainment, sightseeing trips and two banquets (one, a smörgasbord) have been arranged by Dr. L. L. Stillman's entertainment committee.

Exhibit space is under supervision of Dr. John Shimek; transportation is being handled by Dr. Leo Meyer.

BOTH CHICAGO COLLEGES ACCREDITED

Two schools of optometry were placed on the accredited list in April by the A. O. A. Council on Education and Professional Guidance. Changed from provisionally accredited to accredited was the Chicago College of Optometry, and Northern Illinois College of Optometry was accredited, both colleges having met all standards set up by the Council.

RIGGS BECOMES B & L. CENTRAL DIVISION

The Riggs Optical Company of Chicago was taken over by Bausch

& Lomb Optical Company in April. The Chicago firm will be known as Bausch & Lomb Optical Company, Central Division, explains Joseph F. Taylor, president. The Riggs branch has been an affiliated distributor for Bausch & Lomb for many years.

AN EVENTFUL DINNER

A new twist was given the annual livery dinner of the 300 year old Worshipful Company of Spectacle Makers in England this year. Those who attended this optometric banquet in London found a seventeenth century setting which gave tradition-lovers an evening long to be remembered. But we can't tell you about it half as well as the reporter in Britain's March OPTICIAN:

"The company dined by the light of tall candles in silver candelabras placed on the long tables, which gave the lovely old hall much the same appearance as it must have had for hundreds of such banquets all through the three preceding centuries. The light shone fitfully on the brilliant decorations of the men, on the silver and glass on the tables, and was reflected from the white shirt fronts of the guests, giving a soft and friendly tone to a most distinguished gathering.

"In this 'Stygian darkness' as one speaker called it, the high rafters seemed far off, almost eerie in their appearance. To heighten the illusion of the past the Drummond Wolff singers sang Elizabethan songs of great charm, and if further proof were needed, the passing round of the loving cup with all the old ceremony supplied it. The atmosphere was rich in that great tradition which the Spectacle Makers, indeed all the City Guilds, have done so much to preserve."

All of which makes us wonder if we Americans aren't sometimes too eager to drop fine traditional practices and too anxious to always come up with a new idea when planning an event. It's something to think about, anyway.

NEW SPECTACLE STYLING

New frames in the news: The American Optical Company announces the AO Zylmont Ful-Vue, a combination zyl and metal frame with "unique design and construction features." The frame has removable eyewires, and other special features. Bejewelled frames by Zenith Optical Laboratory are also new on the market. The "Golden Gem," by Zenith is handset with semi-precious stones; "Zeno-Gram" features engraved initials on the upper rim of the frame to personalize the eyewear.

NEWS BRIEFS

For the first time since 1941, Pennsylvania State College of Optometry is again offering an educational week for practicing optometrists. In June, an educational program featuring 60 lectures on 18 topics will be available for those practitioners wishing to brush up. The dates: June 12-16. . . . A contact lens congress will be held June 10-12 at the Onesto Hotel in Canton, Ohio, featuring a clinical course in fitting Nupuf contact lenses by the dynamic impression technique. Lectures, clinical study, and general discussion of developments in the contact lens field will be on the program. Sponsors plan to make the congress an annual affair. . . . A net profit of $2,190,499.00 for 1949 was announced recently by American Optical Company. Annual sales amounted to $55,637,461.00 compared to $59,230,792.00 for 1948. Net profit in 1948 was $2,669,900.00. . . . The Dames club of Northern Illinois College of Optometry donated $195.45 to the American Optometric Foundation recently. . . . Dr. Irvin M. Borish appeared on the program of a recent Indiana illumination conference, participating in a symposium on vision, learning and adjustment. The conference took place in the School of Medicine, Indiana University, Indianapolis. Theme of the meeting was "providing visual surroundings for the whole child, physically, mentally, socially and emotionally."

BOOK REVIEW

PHYSIOLOGY OF THE EYE. Vol. I. Optics. Arthur Linksz, M.D., F. A. C. S. (Manhattan Eye, Ear and Throat Hospital, New York) with a foreword by Walter B. Lancaster, M. D., Grune and Stratton, New York, 1950, $7.50.

This is the first of a series of three volumes. The other two volumes planned are Physiology of Vision and Biochemistry of the Eye. As Dr. Lancaster points out in his Foreword to Volume I, the requirements of a good book are that it must be accurate, clear, interesting, that it should not be too condensed and that the illustrations (the drawings) should do what illustrations are supposed to do—make the text clear at a glance.

In all these requisites, Dr. Linksz has succeeded admirably in his Volume I. The author acknowledges that he had drawn upon Duke-Elder's Volume I and what text could be more accurate! The special contribution of Linksz' writing is that he has made the material clear

and interesting. Especially commendable are the illustrations. They are unique and unusually well-done.

Volume I is planned for the beginner interested in the study of the visual sciences and it does fulfill its purpose well. It succeeds in initiating one into the maze of information presented by the great classics of Helmholtz, Hering, Gullstrand, Tscherning, Duke-Elder and Stenstrom.

Part I of the present volume is devoted to the physics of light: the corpuscular theory, the wave theory, the ether-wave fronts, and the velocity of light. These theories are discussed in a most comprehensive and interesting manner as are the following topics of: critical angle, reflection, refraction, interference, polarization, the electromagnetic theory, the photoelectric effect, heat, line spectra, atomic structure, color temperature, photometry—the "Candle" and the "Lumen,"—illumination and brightness, etc.

Part II is concerned with geometric optics: mirrors (plane and curved), refraction by single spherical surfaces and by lenses—cylindrical and prismatic: the aberrations and what can be done about them. In this section the diagrams and text are unusually clear in this rather difficult subject. The writings on geometric optics are so often (to most readers) very dull and incomprehensible: one has to be a born mathematician or physicist to appreciate them. Linksz presents this arid subject as though he were having a conversation with you. His presentation is that which he used in his lectures and he makes you feel as if he were just chatting with you rather than writing a book.

Part III discusses the eye as an image-forming mechanism: analysis is consecutive refracting interfaces, principal focus of the eye, the schematic eye, retinal images, accommodation, axial myopia and its correction, axial hyperopia and its correction, image size, etc.

In general, Dr. Linksz' book is a welcome and much-needed contribution to ophthalmic science, and it will assist significantly in pervading much of the haziness that has, for many individuals, surrounded the subject of optics.

ROBERT E. BANNON.